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JC10 Rec'd PCT/PTO 28 FEB 2002

BOX PCT

ATTORNEY'S DOCKET NO: 24914

U.S. DEPARTMENT OF COMMERCE, PATENT AND TRADEMARK OFFICE		DATE: <u>28</u> February 2002 ( <u>28</u> 02.2002)
TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371		U.S. APPL. NO. (if known): <b>10/069783</b> Not Yet Assigned
INTERNATIONAL APPLICATION NO.: PCT/KR99/00509	INTERNATIONAL FILING DATE: 03 September 1999 (03 09.99)	PRIORITY DATE CLAIMED: None
TITLE OF INVENTION: <b>APPARATUS FOR PREPARING STERILIZING WATER AND PROCESS FOR STERILIZING WATER</b>		
APPLICANT(S) FOR DO/EO/US: <b>KIM, Hee Jung</b>		
<p>Applicant hereby submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information.</p> <ol style="list-style-type: none"> <li>1. <input checked="" type="checkbox"/> This is a <b>FIRST</b> submission of items concerning a filing under 35 U.S.C. 371.</li> <li>2. <input type="checkbox"/> This is a <b>SECOND</b> or <b>SUBSEQUENT</b> submission of items concerning a filing under 35 U.S.C. 371.</li> <li>3. <input checked="" type="checkbox"/> This express request to begin national examination procedures (35 USC 371(f)) The submission must include items(5), (6), (9) and (21) indicated below.</li> <li>4. <input checked="" type="checkbox"/> A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.</li> <li>5. <input checked="" type="checkbox"/> A copy of the International Application as filed (35 U.S.C. 371(c)(2)):             <ol style="list-style-type: none"> <li>a. <input checked="" type="checkbox"/> is transmitted herewith (required only if not transmitted by the International Bureau).</li> <li>b. <input type="checkbox"/> has been communicated by the International Bureau.</li> <li>c. <input type="checkbox"/> is not required, as the application was filed in the United States Receiving Office (RO/US)</li> </ol> </li> <li>6. <input type="checkbox"/> A English translation of the International Application as filed (35 U.S.C. 371(c)(2)).</li> <li>7. <input checked="" type="checkbox"/> Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))             <ol style="list-style-type: none"> <li>a. <input type="checkbox"/> are attached hereto (required only if not transmitted by the International Bureau).</li> <li>b. <input type="checkbox"/> have been communicated by the International Bureau.</li> <li>c. <input type="checkbox"/> have not been made; however, the time limit for making such amendments has NOT expired</li> <li>d. <input checked="" type="checkbox"/> have not been made and will not be made.</li> </ol> </li> <li>8. <input type="checkbox"/> An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).</li> <li>9. <input type="checkbox"/> An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).</li> <li>10. <input type="checkbox"/> A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).</li> </ol> <p><b>ITEMS 11 to 20 BELOW CONCERN OTHER DOCUMENT(S) OR INFORMATION INCLUDED:</b></p> <ol style="list-style-type: none"> <li>11. <input type="checkbox"/> An Information Disclosure Statement under 37 CFR 1.97 and 1.98</li> <li>12. <input type="checkbox"/> An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.</li> <li>13. <input checked="" type="checkbox"/> A <b>FIRST</b> preliminary amendment.</li> <li>14. <input type="checkbox"/> A <b>SECOND</b> or <b>SUBSEQUENT</b> preliminary amendment</li> <li>15. <input type="checkbox"/> A substitute specification.</li> <li>16. <input type="checkbox"/> A change of power of attorney and/or address letter.</li> <li>17. <input type="checkbox"/> A computer-readable form of the sequence listing in accordance with PCT Rule 13ter2 and 35 USC 1821 - 1825</li> <li>18. <input type="checkbox"/> A second copy of the published international application under 35 USC 154(d)(4)</li> <li>19. <input type="checkbox"/> A second copy of the English language translation of the international application under 35 USC 154(d)(4)</li> <li>20. <input checked="" type="checkbox"/> Other items or information:</li> </ol> <p>TRANSMITTAL FORM; FEE CALCULATION; INTERNATIONAL PUBLICATION WO 01/17909; INTERNATIONAL PUBLICATION DATE 15 MARCH 2001 CONSISTING OF 22 PAGES INCLUDING; 1 COVER SHEET CONTAINING THE ABSTRACT; 15 PAGES TEXTUAL SPECIFICATION, 2 PAGES OF 5 CLAIMS; 4 SHEETS DRAWINGS; PCT/ISA/210 INTERNATIONAL SEARCH REPORT; PCT/IB/306 NOTIFICATION OF THE RECORDING OF A CHANGE; UNEXECUTED INVENTOR'S DECLARATION; PRELIMINARY AMENDMENT</p>		

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ATTORNEY'S DOCKET NO: 24914

U.S. APPLICATION NO. <b>10/069783</b> (if known) not yet assigned	INTERNATIONAL APPLICATION NO. PCT/KR99/00509	DATE. <b>28</b> February 2002 <del>28</del> 02 2002)
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17 <u>x</u> The following fees are submitted:  <b>Basic National Fee (37 CFR 1.492(a)(1)-(5):</b> Search Report has been prepared by the EPO or JPO:..... \$890.00  International preliminary examination fee paid to USPTO (37 CFR 1.482).....\$690 00  No international preliminary examination fee paid to USPTO (37 CFR 1.482) but international search fee paid to USPTO (37 CFR 1.445(a)(2))..... \$740.00  Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO ..... \$1040.00  International preliminary examination fee (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(2)-(4). .... \$ 100.00  <div style="text-align: right;"><b>ENTER APPROPRIATE BASIC FEE AMOUNT =</b></div>	<u>CALCULATIONS</u>          <b>\$ 1040.00</b>          <b>\$1040.00</b>	<u>PTO USE ONLY</u>
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Surcharge of <b>\$130.00</b> for furnishing the oath or declaration later than <u>  </u> 20 <u>  </u> 30 months from the earliest claimed priority date (37 CFR 1.492(e)).	\$	
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CLAIMS	NO. FILED	NO. EXTRA	RATE		
TOTAL	5 -20=	0	X \$ 18.00	\$	0.00
INDEPENDENT	1 - 3=	0	X \$ 80.00	\$	0.00
Multiple dependent claims(s) (if applicable)			+ \$260.00	\$	0.00
<b>TOTAL OF ABOVE CALCULATIONS =</b>				\$	<b>1,040.00</b>
Reduction by ½ for asserting small entity, if applicable (Note 37 CFR 1.9, 1.27, 1.28).				\$	<b>520.00</b>
<b>SUBTOTAL =</b>				\$	520.00
Processing fee of <b>\$130.00</b> for furnishing the English translation later than <u>  </u> 20 <u>  </u> 30 months from the earliest claimed priority date (37 CFR 1.492(f)).				\$	0.00
<b>TOTAL NATIONAL FEE =</b>				\$	520.00
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). <div style="text-align: right;"><b>\$40.00 per property +</b></div>				\$	<b>0.00</b>
<b>TOTAL FEES ENCLOSED =</b>				\$	<b>520.00</b>
				Amount to be. refunded _____ charged _____	\$ _____ \$ _____

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U.S. APPLICATION NO. (if known) not yet assigned <b>10/069783</b>	INTERNATIONAL APPLICATION NO.  <b>PCT/KR99/00509</b>	DATE: <b>28</b> February 2002 ( <del>27</del> 02.2002)
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a. ☒ One check in the amount of \$520.00 to cover the above fees is enclosed

b. ☐ Please charge my Deposit Account No. 14-0112 in the amount of \$ \_\_\_\_\_ to cover the above fees. (A duplicate copy of this sheet is enclosed.)

c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 14-0112.

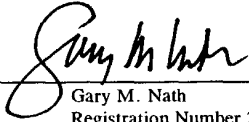
d. Fees are to be charged to a credit card ☐ WARNING. Information on this form may become public ☐ Credit Card Information should not be included on this form. ☐ Provide credit card information and authorization on PTO-2038 ☐

**NOTE:** Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed to request that the application be restored to pending status.

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Rev. 02/98

BOX PATENT APPLICATION  
Attorney Docket No. 24914

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:  
Hee Jung KIM

Serial No. NOT YET ASSIGNED  
Filed: February 28, 2002

For: APPARATUS FOR PREPARING STERILIZING WATER AND PROCESS FOR  
STERILIZING WATER

PRELIMINARY AMENDMENT

Assistant Commissioner for Patents  
Washington, D.C. 20231

Sir:

Before calculating the filing fee for the above identified application, please enter the following amendments:

IN THE CLAIMS:

Please amend claim 5 and add new claim 6 as per the attachments to this preliminary amendment. Pursuant to the new rules implementing the AIPA, a clean copy of the amended claim is attached in Attachment 1, along with a marked-up copy of the claim indicating the proposed claim amendments in Attachment 2.

REMARKS

The above amendments have been made to remove multiple dependencies from the claims, and no new matter has been added.

Respectfully submitted,

NATH & ASSOCIATES

By: 

Gary M. Nath  
Registration No. 26,965

Date: February 28, 2002  
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1030<sup>th</sup> Street, NW - 6<sup>th</sup> Floor  
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GMN/JKH:dd:matter number:AMENDprem1

## ATTACHMENT 1 - MARKED UP COPY OF CLAIM AMENDMENT

5. (Amended) An apparatus for preparing sterilizing water according to claim 3 [or 4], wherein the [hydrogen- or] oxygen-generating catalyst is iridium or ruthenium.

ATTACHMENT 2 - CLEAN COPY OF AMENDED CLAIM:

5. (Amended) An apparatus for preparing sterilizing water according to claim 3, wherein the oxygen-generating catalyst is iridium or ruthenium.

6. (New) An apparatus for preparing sterilizing water according to claim 4, wherein the hydrogen-generating catalyst is iridium or ruthenium.

41 PRTS

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**APPARATUS FOR PREPARING STERILIZING WATER  
AND PROCESS FOR STERILIZING WATER**

**TECHNICAL FIELD**

5       The present invention relates to an apparatus for making water sterilized, which can sterilize various microorganisms living upon the living environment, by electrolysis of water, and a process of the sterilization.

10   **BACKGROUND ART**

Up to the present, disinfectants such as hydrogen peroxide, povidone iodine solution and phenol for preventing infection in a hospital, sodium hypochlorite (NaOCl) for sterilization of food and kitchen, alcoholic  
15   cleaners and agricultural chemicals commonly used in the field of agriculture, have been used.

However, using these chemicals involves problem of occurrence of transformed resistant bacteria upon the increased use of the amount, and causes problems of  
20   environmental pollution and treatment of waste water. In addition, these chemicals have serious problems in safety because they may cause allergy or skin irritation and even death when inhaled in a large amount.

25   **DISCLOSURE OF THE INVENTION**

Thus, the present invention provides a series of electrolyzers which comprises unit cells consisting of anode and cathode chambers having anode and cathode plates at the center of gaskets having plural horizontal members  
30   and plural anode and cathode passages of fan-shape, said anode and cathode chambers being partitioned by ion exchange membrane, to electrolyze water with an electric current of 100 A or less, and electric potential of 100 V or less. According to the invention, an apparatus to  
35   prepare water for sterilizing various kinds of microorganisms with pH 2.0 to 3.5 and redox potential of 950 to 1,200, and a process for the sterilization are

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provided.

#### BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a divisional perspective view of the apparatus according to the present invention, which shows the flow of water.

Fig. 2 is a sectional view of the assembled structure of the apparatus according to the present invention.

Fig. 3 is an extracted perspective view of the apparatus according to the present invention.

#### BEST MODE FOR CARRYING OUT THE INVENTION

The electrolyzer according to the present invention comprises anode chambers (10) and cathode chambers (20) partitioned by ion exchange membrane (40). The anode chamber (10) and cathode chamber (20) form a unit cell (A), and the unit cells are alternately arranged with a close contact. At both sides of the electrolyzer, end plates (60 and 70) having water inlets (61, 61') and water outlets (71, 71'), respectively, are provided to form an outlined construction of the electrolyzer.

As described above, on the end plates (60 and 70), a couple of water inlets (61, 62) and a couple of water outlets (71, 72) are formed, and water being introduced from one water inlet (61) flows through the anode chamber (10) to be discharged as acidic water at one water outlet (71), while water being introduced from the other water inlet (62) flows through the cathode chamber (20) to be discharged from the other water outlet (72) as alkaline water.

Each anode chamber (10) and cathode chamber (20) commonly comprises a gap-control gasket (30) and a gasket for preventing leakage of electrolyte (31) at both sides of anode plate (11) and cathode plate (21), respectively to form a unit cell. In each gasket (30, 31), an anode passage (12) and a cathode passage (22) are respectively formed in a diagonal direction, which leads to an anode

reaction chamber (13) or a cathode reaction chamber (23).

The structure of each electrode plate (11,21) and gasket (30, 31) used in the apparatus for preparing sterilizing water according to the present invention is examined. As illustrated in Fig. 3, circulatory openings are provided on each edge to pass the water that has been introduced through the water inlet (61,62). Plural passages of fan-shape are formed in two openings among them in a diagonal direction, so that water introduced through the circulatory opening may pass out through the passage, and then rapidly pass through each electrode to facilitate electrolytic reaction. Number of the plural passages formed in the circulatory openings are preferably three or more, and more preferably 4. In addition, at the center of gaskets (30, 31), plural horizontal members are provided to prevent deterioration of electrolytic power owing to the contact of ion exchange membrane with the electrode.

According to conventional electrolysis, the life of ion exchange membrane is short because Ca or Mg precipitate produced as a reaction side product is concentratedly deposited on the narrow surface of the membrane when it passes through the narrow passage. However, the apparatus according to the present invention provides a wide passage of fan-shape as illustrated in Fig. 3, so that the precipitate may pass through the ion exchange membrane by smoothly passing the passage, thereby preventing the deterioration of ion exchange membrane. Due to the structure of wide passage of fan-shape, discharge of gas generated from electrolysis is promoted to increase the efficiency of electrolysis, and the lifetime of electrodes become longer.

Since each anode or cathode passage (12, 22) of the anode chamber (10) and cathode chamber (20) is only formed in an opposite diagonal direction, the water introduced from one water inlet (61) moves through each circulatory opening (80) of the anode chamber (10) and then flows into

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the anode reaction chamber (13) through the anode passage (12) formed in each gasket (30,31) in the anode chamber (10), while the water introduced from the other water inlet (62) simply passes through the corresponding opening (80) in which no anode chamber passage (12) has been formed in the unit cell (A) of the anode chamber (10) to reach the cathode chamber (20), where the water discharged from the cathode passage (22) formed in each gasket (30,31) of the cathode chamber (20) flows into the cathode reaction chamber (23). In other words, the water introduced into the anode chamber (10) flows only into the anode reaction chamber to be reacted and then passes through the opening (80) to flow into only the anode chamber (10) of the next unit cell (A), while the water introduced into the cathode chamber (20) flows only into the cathode reaction chamber (23) to be reacted and then repeatedly flows into the cathode chamber (20) of the next unit cell (A).

Now, the operative process of the present invention is described in detail.

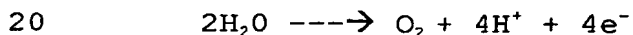
When water is introduced into the electrolyzer through the water inlet (61,62), it is discharged through the upper anode passage (12) formed in the gasket (30, 31) from the first anode chamber (10), upon flowing into the electrolyzer through the circulatory opening (80). The discharged water flows down with the anode plate in contact (11), so that the water loses electrons by electrolytic reaction in the anode reaction chamber (13) to become acidic. The water passes through the lower anode chamber passage (12) while it is electrolyzed, and passes through the opening (80) to simply pass through the next cathode chamber (20). When the water reaches the unit cell (A) of the anode chamber (10) again, the water is discharged through the lower passage (12) of each gasket (30, 31), and then passes again through the upper passage (12), and further electrolyzed by contacting with the anode plate (11) in the anode reaction chamber (13) to

become more acidic.

Meanwhile, the water introduced through the other water inlet (62) simply passes through the unit cell (A) of the first anode chamber (10) via the circulatory opening (80) to reach the cathode chamber (20) and then discharged through the upper cathode passage (22) formed in each gasket (30, 31) of the cathode chamber. Then, the water flows down with the cathode plate in contact (21) in the cathode reaction chamber (23) to gain a large amount of electrons by electrolysis and becomes alkaline.

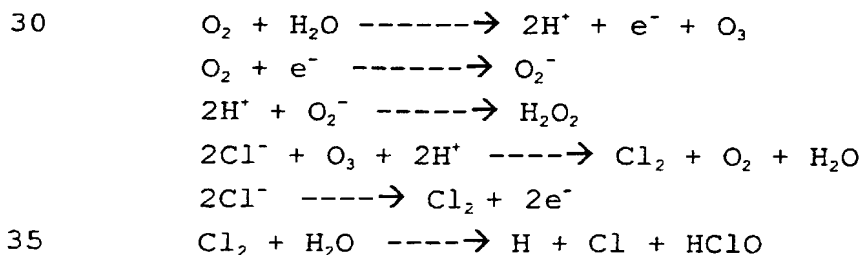
The water reacted as described above is discharged via the lower cathode passage (22) to pass through the opening (80) and then flows into the cathode reaction chamber (23) via the cathode passage (22) of the cathode chamber (20) to be subjected to the repeated operation of electrolysis.

In the anode chamber (10), oxygen, hydrogen ion and oxygen radical are generated by oxidation of water to give acidic water.



At this time, oxygen (O<sub>2</sub>) is dispersed into the air to increase the concentration of hydrogen ion in the anode chamber to raise pH and the redox potential.

Meanwhile, the substances in molecular state, such as oxygen, carbon dioxide and calcium carbonate and the anions such as chloride ion or bicarbonate ion, which are contained in piped or underground water, are reacted as follows to give ozone, superoxide anion, hydrogen peroxide and hypochlorous acid.

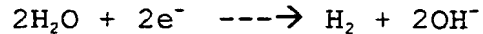


On the other hand, in the cathode chamber (20), hydrogen and hydroxide ion are generated by reduction of

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water as follows to give alkaline water.



The method for preparing acidic water and alkaline water by means of electrolysis of water using anode and cathode has been generally used.

However, the present invention provides more effective apparatus for preparing acidic and alkaline water by using such anode and cathode chambers, and further provides a structural apparatus to produce sterilizing water with excellent sterilizing effect in a large scale.

According to the present invention, the anode plate (11) and the cathode plate (21) use proper catalysts to promote the reaction of the anode chamber and reaction of the cathode chamber respectively.

The anode plate (11) generally employs a dimension stable anode (DSA) using oxides of iridium or ruthenium as an oxygen-generating catalyst or platinum plating on titanium substrate.

The cathode plate (21) employs hydrogen or oxygen generating catalyst (such as oxides of iridium or ruthenium) in addition to stainless steel, nickel, mild steel or titanium substrate.

The ion exchange membrane (40) comprises of fluoro-resin or hydrocarbon type ion exchange membrane. According to the present invention, the electrolytic potential is lowered by using Sn-Ir-Pt complex electrode having low hydrogen generation potential, while the gap-control gaskets (30) which adjust the distance between the electrodes are provided with a thickness of 2 mm or less, considering the potential between an electrode and the other.

Further, the material for the gap-control gaskets (30) and gaskets for preventing leakage of electrolytes (31) is generally selected from EDPM rubber, silicone, teflon, and the like.

The unit cell (A) of the present invention is set in

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a housing frame and is tightly assembled by using nuts and bolts. All anodes and cathodes of the present invention are electrically connected to the positive and negative terminals of a current supply source, while the outlet for  
5 the acidic water has a sensor for detecting the redox potential so that it may continuously measure the value to control the potential of a rectifier using a controller or to control the acidity using a flow controller.

According to the present invention, the electric  
10 current is set to a level of not higher than 100 A, while the voltage is set to a level of not higher than 100 V, depending upon the flow rate of water supplied to the electrolyzer. The system is evaluated by measuring electric potential and pH by the lapse of time so as to  
15 obtain acidic water of high quality.

The acidic water electrolyzed via the electrolyzer according to the present invention has pH of 2.0 to 3.5 and very high redox potential of 950 to 1,200 mV. That is, the acidic water has strong sterilizing action, since it  
20 has such a low electron concentration that takes the electrons of bacterial cells instantly to break the cell membrane and extinguish bacteria.

The sterilizing water prepared according to the present invention is generated from an apparatus for  
25 preparing electrolyzed water, which is divided into anode and cathode chamber. The acidic water in the anode comprises superoxide ( $O_2^-$ ), hydrogen peroxide, ozone, hypochlorous acid, or the like, having strong oxidizing ability which oxidizes or denaturalizes the amino acid  
30 group on the surface of bacteria or fungi harmful to a human body or environment. Thus, the water has strong sterilizing power to extinguish the harmful bacteria in 5 to 30 seconds.

Accordingly, the apparatus for preparing sterilizing  
35 water according to the present invention can be used for preventing harmful insects, for sterilization and cleaning of various agricultural and stockbreeding products in the

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field of agriculture and stockbreeding, as well as cleaning of devices or human body to prevent infection in the field of medical treatment. Further, the apparatus can be widely used for various applications, for example, sterilizing or controlling sanitary condition in food processing industries, restaurants, hotels or houses.

In the apparatus for electrolyzing water according to the present invention, depolarized ion exchange membrane (40) is provided to prevent hydrogen ion generated in the anode chamber (10) from being moved into the cathode chamber (20), while preventing hydroxyl ion generated in the cathode chamber (20) from being moved into the anode chamber (10) to maximize the productivity of water.

The ion exchange membranes (40) usable in the electrolytic system according to the present invention include commercially available ion exchange membranes such as fluoride or hydrocarbon type ion exchange membrane merchandised by Dupont Co. of U.S.A., Asahi Chemical Co. or Asahi Glass Co. of Japan, or depolarized ion exchange membranes comprising integrated anion and cation exchange membrane manufactured by Dokuyama Soda Co. of Japan.

The invention is described in more detail by referring to the examples below, but it should be noticed that the present invention is not restricted to the examples by any means.

#### Example 1

Tap water is supplied into an electrolyzer according to the present invention at a flow rate of 10 liter per minute, and the current is constantly supplied as 50 A. Electric potential and pH are measured with the lapse of time to evaluate the system and to prepare acidic water. The physicochemical properties of sterilizing water finally obtained by the apparatus according to the present invention were compared with conventional piped water, and the results are shown in Table 1.

Table 1. Physicochemical properties of the

sterilizing water of the present invention

	Sterilizing water of the present invention	Tap water
PH	2.0 - 3.5	6.8 - 7.7
Redox potential (mV)	950 - 1,200	350 - 550
Conductivity ( $\mu\text{s}/\text{cm}$ )	1.7	1.4
$^{17}\text{O}$ -NMR half-width (Hz)	55 - 65	140 - 150

Example 2: Test for sterilizing ability

5 (1) Preparation of inoculation source

The test sample at the contact time "0" and the control sample were properly diluted with beef broth culture medium after 24 hour cultivation to make the regenerated bacterial number  $1-2 \times 10^6$ , and the resultant  
10 bacterial solution 1 ml was used as an inoculation source. For the dilution of the culture medium, physiological saline was used.

(2) Preparation of test sample and control sample

In an 237 ml of wide neck glass container having a  
15 screw-type lid, test sample and control sample were prepared respectively. For the control sample, the same amount of phosphoric buffer solution without containing the test sample was placed. The control sample inoculated with bacteria was used as a control means against the  
20 inoculated test sample.

(3) Inoculation and cultivation of test sample and control sample

Bacteria cultivated for 24 hours was shaken and stood for 15 minutes before preparing the inoculation source.  
25 Then, 1 ml of the inoculation source was carefully dropped on the test sample and control sample to be evenly dispersed.

Phosphoric buffer solution (pH 7.2) was added as a neutralizing solution to each glass vessel containing

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inoculated control sample and glass vessel containing inoculated test sample soon after inoculation (within 30 seconds). The sample was diluted, and a portion was taken and inoculated by thinly spreading it on a plate medium containing agar and tryptophan glucose extract. The inoculated samples were cultivated in a plate cultivator at 37°C for 48 hours, and the number of bacteria was counted.

The results are shown in Table 2.

Table 2: Sterilizing power of the sterilizing water of the present invention

	Control sample (5 min)	No. of bacteria after treating with sterilizing water of the invention for 30 seconds (cfu/ml)	Sterilizing power (%)
<i>E. coli</i> O-157	$3.6 \times 10^3$	0	99.9
<i>Salmonella typhimurium</i>	$3.2 \times 10^3$	0	99.9
<i>Bacillus subtilis</i>	$2.0 \times 10^3$	0	99.9
<i>Enterobacter cloacae</i>	$3.0 \times 10^3$	0	99.9
<i>Klasiella pneumoniae</i>	$3.3 \times 10^3$	0	99.9
<i>Shigella flexneri</i>	$3.6 \times 10^3$	0	99.9
<i>Candida albicans</i>	$2.6 \times 10^3$	0	99.9
<i>Trichophyton rubrum</i>	$2.6 \times 10^3$	0	99.9
<i>Aspergillus niger</i>	$2.2 \times 10^3$	0	99.9

Penicillium funiculosum	$3.2 \times 10^3$	0	99.9
Valsa ceratosperma	$3.8 \times 10^3$	0	99.9

As can be seen from the results of Table 2, it was confirmed that sterilizing water prepared from the apparatus for preparing sterilizing water according to the present invention has an excellent sterilizing power against bacteria causing food poisoning or pathogenic infections and fungi causing sanitary or infectious problems in the environment or daily commodities.

Example 3: Effect of preventing agricultural diseases

(1) Preparation of inoculation source

Each sample infected with red pepper white powder disease, cucumber bacterial disease, cucumber white powder disease, grape bacterial disease, strawberry white powder disease, bacterial brown spot of agaric and green mold disease was taken, and the infectious bacteria was isolated. The isolated strain was cultivated in nutrient agar medium at 25°C. The concentration of living bacteria was measured by subsequent dilution of the cultured bacteria.

(2) inoculation of the cultured bacteria and measurement of number of living bacteria

Sterilizing water (9.9 ml) prepared according to Example 1 of the present invention was charged in a test tube, and each 0.1 ml of bacteria at a concentration of  $10^{10}$ /ml was inoculated, and the mixture was reacted for 30 seconds. The reaction mixture (0.1 ml) was inoculated on nutrient agar medium (which had been previously prepared), and cultivated at 25°C for 24 hours. The number of colonies generated was counted to determine the extinction rate. For the control group, identical experiments were repeated by using commercially available agricultural chemicals.

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The results are shown in Table 3 below.

Table 3. Effect of preventing agricultural diseases

		Prevention (%)		
		Sterilizing water of the invention	Commercially available agricultural chemicals	No treatment
red pepper white powder disease		67.8	51.0	0
Cucumber bacterial disease		21.4	17.7	0
Cucumber white powder disease		77.9	66.1	0
grape bacterial disease		90.8	91.7	0
Strawberry white powder disease		76.8	78.4	0
Agaric	Bacterial brown spots	72.8	-	0
	Green mold disease	90.7	-	0

5 As seen in the results of Table 3, sterilizing water prepared by the apparatus according to the present invention has an effect for preventing agricultural diseases, and the effect is more excellent than that of commercially available agricultural chemicals.

10

#### Example 4: Sterilizing effect when washing hands

After applying E. coli on a hand, the hand was washed by being soaked in 5 liter of the sample. Then, four fingers were rubbed on a medium to measure the number of  
 15 remained bacteria. For the control, Super-Sterilizer and Alpet-E (commercially available hand sterilizers) were used. Identical tests were repeated six times, and the

mean values are shown in Table 4 below.

Table 4: Sterilizing effect when washing hands

	No. of remaining bacteria after washing	Reduction rate of bacteria (%)
Untreated group	$1.0 \times 10^5$	-
Super-Sterilizer	$1.5 \times 10^2$	99.8
Alpet-E	$4.9 \times 10^2$	99.5
Sterilizing water of the invention	3	99.9

5 As shown in the results of Table 4, the sterilizing water prepared by the apparatus of the present invention has an excellent sterilizing effect as compared with commercially available sterilizers for washing hands and thus can be employed as a sterilizer for medical use.

10

#### Example 5: Test of toxicity

##### (1) Test for acute toxicity

A test for acute toxicity of the sterilizing water prepared according to Example 1 was performed by using 5 weeks-old ICR mouse having a body weight of  $20 \pm 3$  g. As a critical test, 5000 mg/kg of sterilizing water was administered, and the concentration was adjusted to 500 mg/ml. The sample was orally administered once at a rate of 1 ml/100 g. For a negative control, the sterilized physiological saline was administered.

For 6 hours after administration, the animals were observed every hour. Then, activity, appearance and symptoms related to autonomic nerves of the mice were carefully observed once a day during 14 days thereafter. A body weight of each animal was measured on the day of administration and 5 days after the administration, and compared with that of the control group. No extraordinary change was found.

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## (2) Test of eye irritation

A test of eye irritation by sterilizing water prepared from Example 1 of the present invention was performed by using 3-4 months-old New Zealand white rabbits, each having a body weight of 2.0 to 3.0 kg. Nine rabbits were selected, and 0.1 ml of sterilizing water prepared from Example 1 was administered dropwise on the eye membrane of right eye of each rabbit. After 30 seconds, both eyes of three among them were washed with sterile physiological saline for 1 minutes, while the eyes of remaining 6 rabbits were not washed. The left eye of each rabbit, with no administration of sample, was used as a control.

After administering sterilizing water, the rabbits were observed everyday in view of general symptoms and intake of food and water. The eye test was performed after 1, 24, 48, 72 and 96 hours, and seven days after administration of sterilizing water. On the basis of the table for judging the eye membrane irritation and table for grading pathological change of eyeballs according to "the Standard for Toxicity Test of Medicines or the like", Notification No. 94-3 by the National Health and Safety Institute, the pathological change of each eye was graded, and the state of irritation was evaluated.

As a result, it was confirmed that no substantial irritation was found on the eye membrane of the test rabbits.

Example 6: Test of Durability

An apparatus for preparing sterilizing water equipped with the gasket according to the present invention and an apparatus for electrolysis employing a gasket having a single passage without a horizontal member instead of the gasket according to the invention, as a comparative example, were operated for about six months in an identical condition. After 6 month operation, the ion exchange membrane of each electrode was taken and

photographed. (Figs. 4A and 4B)

As seen in Fig. 4, in case of using a gasket of conventional structure, Ca or Mg precipitate generated as a side product of electrolysis was deposited on the ion exchange membrane (left of Fig. 4A) or the electrode (left of Fig. 4B), which could not be used further. On the other hand, the apparatus for preparing sterilizing water according to the present invention showed much less deposition of precipitate on the ion exchange membrane (right of Fig. 4A) and no deposition of precipitate at all on the electrode (right of Fig. 4B).

As described above, sterilizing water prepared with a very low electric potential according to the present invention shows an excellent sterilizing power against various microorganisms and thus can be advantageously used in the field of agriculture and medical treatment as well as everyday life. Sterilizing water prepared by the apparatus according to the present invention, though being consisting of pure water, shows an excellent sterilizing power, and thus it does not cause environmental pollution as compared to conventional chemical sterilizers, thereby contributing to environmental protection.

## CLAIMS:

1. An apparatus for preparing sterilizing water, which comprises an electrolyzer wherein an anode chamber (10) and a cathode chamber (20) partitioned by an ion exchange membrane (40) form a unit cell(A), being alternately arranged and successively equipped with close relation; water inlets (61, 62) and water outlets (71, 72) are provided on the end plate (60,70) at both ends of the electrolyzer; said anode chamber (10) and cathode chamber (20) having circulative openings at the vicinity of each edge at both side centered from anode plate (11) and cathode plate (21), of which two circulative openings of diagonal direction among them have plural passages of fan-shape, in order for water introduced through the openings to pass through the passages to rapidly go through each electrode; and a gap-control gasket (30) and a gasket for preventing leakage of electrolyte (31) having plural horizontal members are provided at the center to form an anode reaction chamber (13) and a cathode reaction chamber (23).
2. An apparatus for preparing sterilizing water according to claim 1, wherein the anode passage (21) and the cathode passage (22) formed in each gasket (30, 31) make the water introduced through the water inlet (61, 62) flow in through the anode passage (12) and the cathode passage (22).
3. An apparatus for preparing sterilizing water according to claim 2, wherein a dimension stable anode (DSA) using an oxygen-generating catalyst or platinum plating on titanium substrate is employed as an anode plate (11).
4. An apparatus for preparing sterilizing water according to claim 2, wherein the cathode plate (21)

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employs hydrogen-generating catalyst in addition to the substrate made of stainless steel, nickel, mild steel or titanium.

- 5 5. An apparatus for preparing sterilizing water according to claim 3 or 4, wherein the hydrogen- or oxygen-generating catalyst is iridium or ruthenium.

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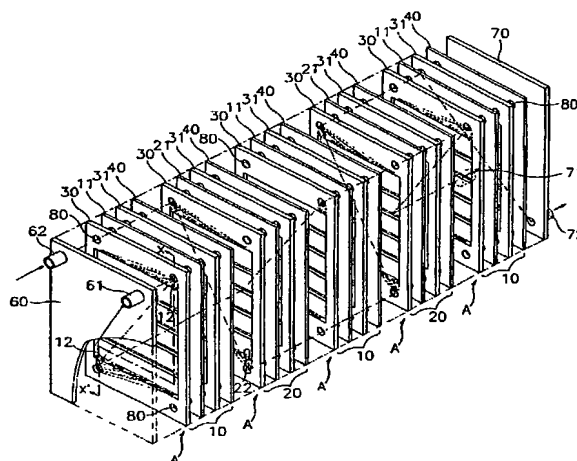
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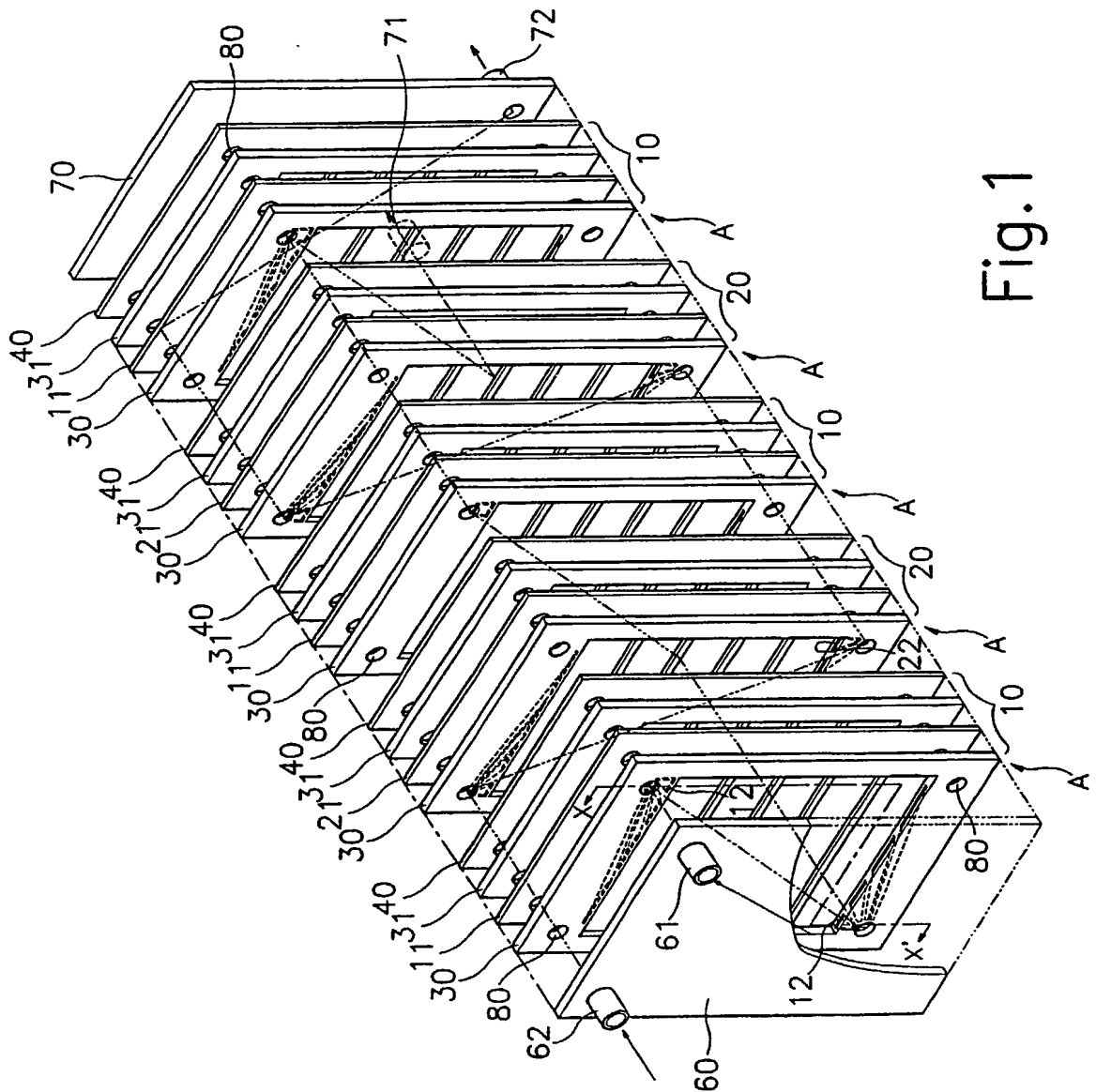
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(54) Title: APPARATUS FOR PREPARING STERILIZING WATER AND PROCESS FOR STERILIZING WATER



(57) Abstract: The present invention provides an apparatus for preparing sterilizing water, which comprises an electrolyzer wherein an anode chamber (10) and a cathode chamber (20) partitioned by an ion exchange membrane (40) form a unit cell (A), being alternately arranged and successively equipped with close relation; water inlets (61, 62) and water outlets (71, 72) are provided on the end plate (60, 70) at both ends of the electrolyzer; said anode chamber (10) and cathode chamber (20) having circulative openings at the vicinity of each edge at both sides centered from anode plate (11) and cathode plate (21), of which two circulative openings of diagonal direction among them have plural passages of fan-shape, in order for water introduced through the openings to pass through the passages to rapidly go through each electrode; and a gap-control gasket (30) and a gasket for preventing leakage of electrolyte (31) having plural horizontal members are provided at the center to form an anode reaction chamber (13) and a cathode reaction chamber (23).

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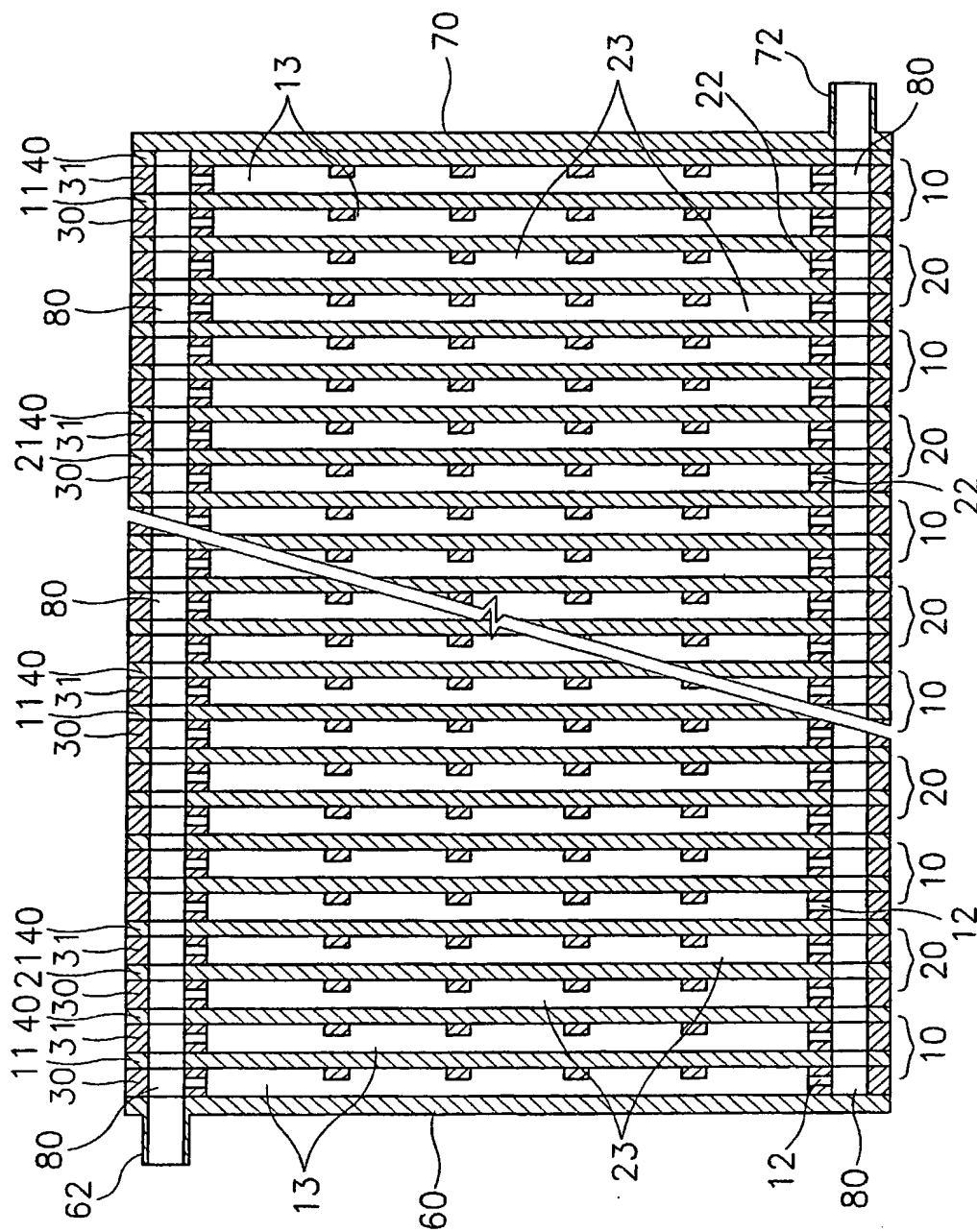


Fig. 2

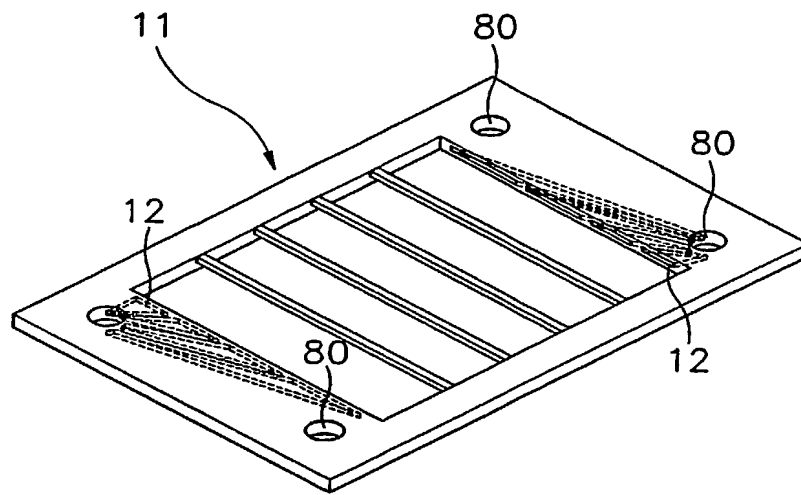


Fig.3

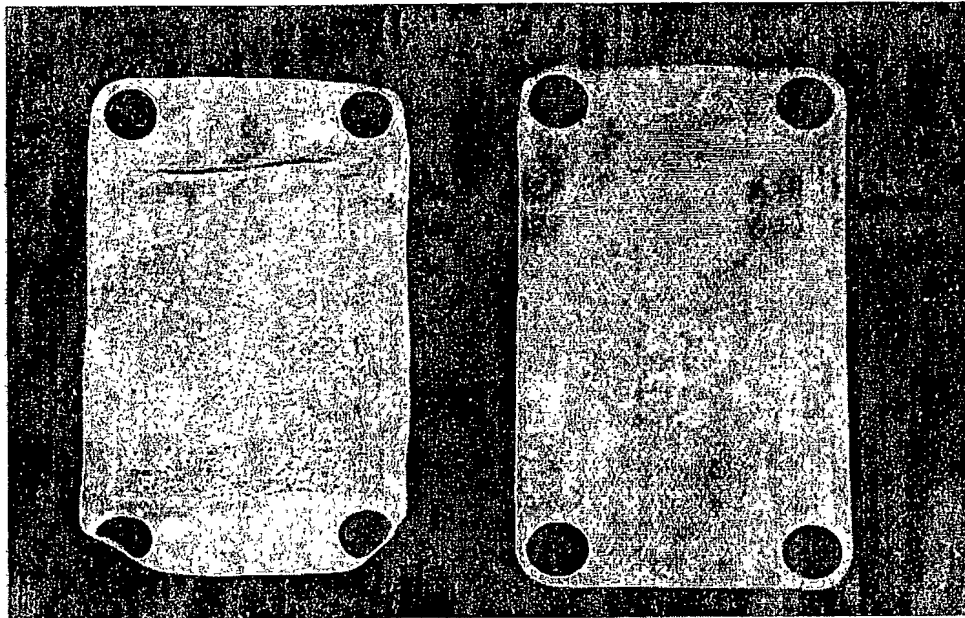


Fig.4a

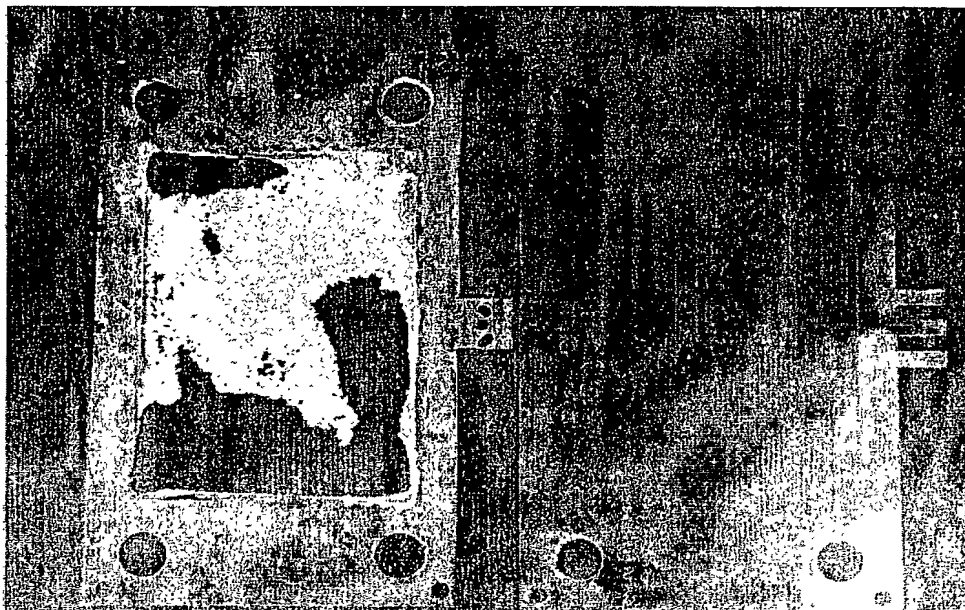


Fig.4b

## DECLARATION FOR PATENT APPLICATION

Attorney Docket: 24914  
Page 1 of 2

As a below-named inventor(s), I/we hereby declare that:

My/Our residence(s), post office address(es) and citizenship(s) is/are as stated below next to my/our name(s).

I/We believe I/we am/are the original inventor, first and sole (if only one name is listed below) or the original, first and joint inventors (if plural names are listed below) of the subject matter which is claimed, and for which a patent is sought on the invention entitled: **APPARATUS FOR PREPARING STERILIZING WATER AND PROCESS FOR STERILIZING WATER**

the specification of which: (check one)

☐ is attached hereto.

☒ was filed on 3 September 1999, as Serial No. PCT/KR99/00509, and  
February 28, 2002, as Serial No. 10/069,783,

and was amended on \_\_\_\_\_ (if applicable).

We hereby state that we have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

We acknowledge the duty to disclose information which is material to the patentability of this application as defined by 37 CFR § 1.56.

We hereby claim foreign priority benefits under 35 U.S.C. § 119 of any foreign application(s) for patent or inventor's certificate listed below, and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Applications: N/A

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(Application No.)	(Country)	(Day/Month/Year Filed)	<input type="checkbox"/> Yes	<input type="checkbox"/> No
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(Application No.)	(Country)	(Day/Month/Year Filed)	<input type="checkbox"/> Yes	<input type="checkbox"/> No

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We hereby claim the benefit under 35 U.S.C. § 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by 35 U.S.C. § 112, first paragraph, I/we acknowledge the duty to disclose material information as defined in 37 CFR § 1.56 which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

(U.S. Application Serial No.)

(U.S. Filing Date)

(Status--patented, pending, abandoned)

(U S Application Serial No )

(U S Filing Date)

(Status--patented, pending, abandoned)

DECLARATION FOR PATENT APPLICATION

Attorney Docket: 24914  
Page 2 of 2

I/We hereby claim the benefit under 35 U.S.C 119(e) of any United States provisional application(s) listed below:

(Application Number(s))

Filing Date

We hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements are made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. § 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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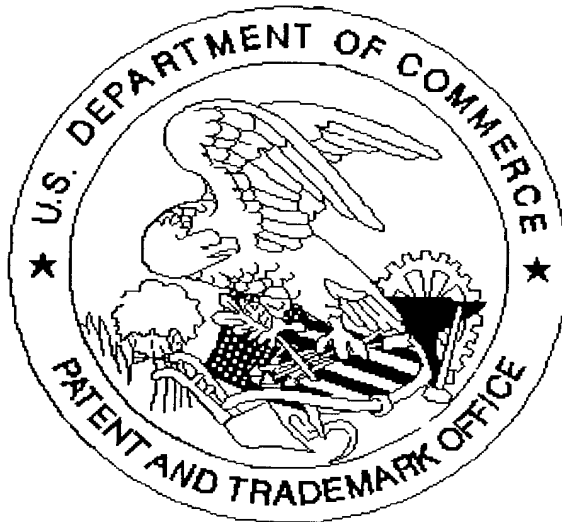
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